**MOM Rainbow Demo**

**Ministry Expectations:** This demonstration can be applied to the following grade levels:

1. **SNC2P** (Expectations: C2.1, C2.5, C2.6) ; **SNC2D** (Expectations: C2.6, C3.6, C3.7) 🡪At the grade 10 level, this demonstration focuses on classifying acids and bases, investigating acid-base indicators, and becoming familiar with neutralization reactions.
2. **SCH3U** (Expectations: C2.1, C2.9, E2.1)🡪 At the grade 11 level, this demonstration supports the further investigation of neutralization reactions and solubility.
3. **SCH4U** (Expectations: E3.1, E3.3) 🡪 In grade 12, this demonstration can be used when explaining Le Châtelier’s principle.

**Introduction:** In this demonstration, Milk of Magnesium (MOM) will undergo a neutralization reaction with hydrochloric acid (HCl). Universal indicator will be added to the mixture to visually display the changing pH that occurs during the reaction. As the neutralization reaction occurs, a variety of colours will be observed as the solution goes from basic (purple), to neutral (green), to acidic (orange), and back to the original purple colour.

**Materials:**

-1M HCl -Milk of Magnesium -500mL Round bottom flask -Universal Indicator -H2O -NaOH

**Safety:**

Goggles and gloves are to be worn for protection against the acids and bases used. Waste can be disposed of with excess water down the drain.

**Procedure:**

1. Obtain 600mL beaker. Add stir rod and 500mL of water. Place on top of stir plate
2. Add ~10-15mL of milk of magnesium and add a ~10 drops of universal indicator.Make sure the stir plate is turned on. Record the colour of the solution.
3. Add 10mL of 1M HCl and observe the colour changes. Gradually add small amounts of HCl and note all colour changes. Continue adding the acid in small increments until the solution remains a constant orange and is clear.
4. Add ~10mL of milk of magnesium and note the colour change.

**Results/Explanation/Teacher Notes:**

The following reactions occur in the demo: **a)** Mg(OH)2(s) 🡪 Mg2+(aq) + 2OH-(aq) (slow)

**b)** H+(aq) + OH-(aq) 🡪 H2O(l)  (fast)

The purpose of this demonstration is to visually display neutralization reactions, how indicators work in identifying pH, and how reactions can be reversible (common misconception). Milk of Magnesium (magnesium hydroxide) is a strong base that is almost insoluble in water. However, it does slowly dissociate, creating hydroxide ions in solution which react with the universal indicator to create a purple coloured solution. As HCl is poured into the basic solution, a rainbow of colours will appear as the neutralization reaction takes place (purple🡪green🡪orange🡪green🡪purple). With each addition of HCl, H+ reacts with the dissociated OH- from Mg(OH)2 until there are only a few OH- remaining. At this point, an orange colour remains indicating an acidic solution. This colour can be reversed by adding more milk of magnesia, in which there will be more OH- ions present than H+. Therefore, the universal indicator will react with the surplus of OH- and produce a purple solution again. *This is a versatile demonstration to use that may apply to many grade levels, each time taking a different perspective.*

**References:** a) Carolina Biological: <http://www.youtube.com/watch?v=dwNboZesSs4>

**Introduction:**

Indicators are very useful in identifying acidic and basic solutions. Universal indicator has a wide spectrum of colours to help differentiate substances (base=purple, neutral=green, acid= orange/red).

Today, we are going to investigate the neutralization reaction of Milk of Magnesia (magnesium hydroxide) and hydrochloric acid, while using universal indicator to monitor the pH of the solution. While watching the demonstration, take careful observation of the colour changes that occur, and speculate what is happening to cause the change in colour.

**Reactions Occurring**: **a)** Mg(OH)2(s) 🡪 Mg2+(aq) + 2OH-(aq) (slow)

**b)** H+(aq) + OH-(aq) 🡪 H2O(l)  (fast)

**Observations:**

|  |  |  |
| --- | --- | --- |
| **Steps in the Demo** | **Colour** | **Notes** |
| Milk of Magnesium + water + indicator |  |  |
| Milk of Magnesium + water + indicator + first addition of HCl |  |  |
| Milk of Magnesium + water + indicator + next few additions of HCl |  |  |
| Extra Milk of Magnesium added |  |  |

1. What ions are reacting to carry out the neutralization reaction?
2. After the first addition of HCl, the solution becomes orange but returns back to purple. Why does the orange colour disappear?
3. After many additions of HCl, the solution remains orange. Why is the solution not turning back to purple?
4. Explain why the solution returned to its original purple colour when additional milk of magnesium was added.
5. If the lab ran out of hydrochloric acid, what would be a good alternative to use that is readily accessible? (*hint: common household item)*